INITIAL REVIEW ENGINEERING REPORT [redacted]
PMN: 15-0487 0488, 0489, 0490, 0491

Focus Ready Draft 6/22/2015
ENGINEER: Prothero \ EV \ JAS
PV (kg/yr): [redacted] Import Only

SUBMITTER: Daewoo International USA Corp

USE: Additive for electro-static discharge (ESD) in electronic devices, electronics, and materials ([redacted] additive for weight reduction in materials ([redacted] additive to improve mechanical properties or electrical conductivities ([redacted] a heat-generating element in heating devices and materials ([redacted] additive for heat transfer and thermal emissions in electronic devices and materials ([redacted] semi-conductor, conductive, or resistive element in electronic circuitry and devices ([redacted] additive to improve conductivity in electronic circuitry, energy storage systems, and devices ([redacted] electron emitter for lighting and x-ray sources ([redacted] additive for electromagnetic interface (EMI) shielding in electronic devices ([redacted] additive for electrodes in electronic materials and electronic devices ([redacted] catalyst support in chemical manufacturing ([redacted] coating additive to improve corrosion resistance or conductive properties ([redacted] additive for fibers in structural and electrical applications ([redacted] additive for fibers in fabrics and textiles ([redacted] filter additive to remove nanoscale materials ([redacted] semi-conducting compounding additive for high-voltage cable ([redacted] and additive for super-hydrophobicity ([redacted] Consoildated Set: P-15-487, P-15-488, P-15-489, P-15-490, and P-15-491.

OTHER USES: [redacted]

[redacted]

MSDS: Yes Label: No

Gen Eqpt: A system of local and/or general exhaust is recommended to keep employee exposures above the Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. The use of local exhaust ventilation is recommended to control emissions near the source. // Wear primary eye protection such as splash resistant safety goggles with a secondary protection face shield. /// Wear appropriate gloves. /// Wear appropriate clothes.

Respirator: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use. (1) Dust, mist, fume-purifying respiratory protection: any air-purifying respirator with a corpuscle filter of high efficiency; any respiratory protection with a electromotion fan (for dust, mist, fume-purifying) high-efficiency particulate filter respirator attached self-service protector. (2) For unknown concentration or immediately dangerous to life or health: supplied-air respirator (hybrid air-line mask) or supplied-air respirator with full facepiece.

Health Effects: Causes serious eye irritation. May cause respiratory tract irritation.

TLV/PEL:

[redacted]

CRSS :

Chemical Name: Multi-walled carbon nanotubes
S-H20: 1E-06 g/L @
VP: 1.0E-6 torr @
MW: %<500 %<1000
Physical State and Misc CRSS Info:

Neat: Solid Mfg: NK: Import Proc/Form: Solid: [redacted] PMN material in formulation End Use: [redacted]. The molecular weight is variable and depends on the size of the nanotube. It is estimated to be >1,000,000 g/mole. The combined production volume for the consolidated set is INIT: [redacted] kg/yr; MAX: [redacted] kg/yr. Submitted Properties: Agglomerates as bundles; Number of Walls = 5-20; CNT Diameter = 8-30 nm; CNT Length = 1-20 µm, CNT Aspect Ratio > 200; Bundle Length = 10-50 µm; Bundle Aspect Ratio = 0.7-50; Wall Ends = Closed; Purity > 93%; Catalyst Particle Size = 1-150 µm; WS = Insoluble; Density = 0.015-0.030 g/cc [redacted], 0.060-0.140 g/cc [redacted]); Particle Size (6 runs): D10 = 10.00-11.56 µm, D50 = 33.35-39.52 µm, D90 = 101.97-134.54 µm. Estimated Properties: VP < 0.000001 torr (High MW); WS < 0.000001 g/L (High MW).

Consumer Use: No

SAT (concerns) (06/12/2015):

Related Cases and Misc SAT Info:
Analogs: [redacted]

Migration to groundwater: negl-rapid

PBT rating: P3B3T2 SAT rating below are identical for all PMNs in the consolidated set.

Health: 2 Dermal, Drinking Water, Inhalation

Eco: 1 Water (All releases to water with a CC = ppb)

OCCUPATIONAL EXPOSURE RATING: [redacted]

NOTES & KEY ASSUMPTIONS:
Generated by the 09/30/2013 version of ChemSTEER. The PMN is a multi-walled carbon nanotube. The PB rating is P3B3; therefore a full assessment required. The PMN is part of a consolidated set (P15-487 to 491). The PMN is import-only; therefore, manufacturing is not assessed. Submission states PMN is prepared in both powder and pellet forms ([redacted] distribution across each PMN; see Attachment 9 for detailed PV distributions). See Attachment 10 for particle size distribution (PSD) data. As a conservative estimate, EPA assesses potential inhalation exposures and air releases to solid particulate. /// No same-submitter past cases found. Past nano submissions with similar breadth of uses were referenced for consistency: [redacted] /// Consistent with [redacted], this IRER consolidates most of the uses into a single operation. The remainder of the PV is assessed as coating formulation and application. For all past cases, releases and exposures as assesed for solid particulate. Releases are primarily to uncertani media, except for instances where submitter information is provided. Non-coating uses in past cases assess dust loss during unloading, container cleaning, and equipment cleaning (consistent with this IRER). Coating use in [redacted] assessed releases and exposures using the Automobile Refinish Spray Coating model (consistent with this IRER).

POLLUTION PREVENTION CONSIDERATIONS:
P2 Claim: The new chemical substance is expected to offer the following Pollution Prevention benefits: (1) The new chemical substances when used as an additive in materials increase the wear and life of the material through the reduction of friction and increase in material strength. This results in extended material and product life, as well as reduced energy consumption. (2) The new chemical substances may be used to enhance the conductivity of electronic devices. This is expected to result in reduced energy consumption and improved energy efficiency and output.

EXPOSURE-BASED REVIEW: No

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Use 1: Incorporation as Additive in Articles ([redacted] PV)

Number of Sites/ Location: [redacted]

unknown site(s)

Days/yr: [redacted]

Basis: The submission estimates [redacted] use sites. EPA assesses 93% of the PV for this operation and therefore assesses 93% of the use sites: ([redacted] sites) x [redacted] = ~[redacted] sites. EPA also assumes [redacted] days/yr (consistent with # of exposure days estimated in submission). CS calculates [redacted] kg/st-day.

Process Description: [redacted] (per Submission)

ENVIRONMENTAL RELEASES ESTIMATE SUMMARY

IRER Note: The daily releases listed for any source below may coincide with daily releases from the other sources to the same medium.

Water or Air or Incineration or Landfill
Conservative: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain (per model)
from: Unloading Solid Raw Material from Transport Containers
basis: EPA/OPPT Solids Transfer Dust Loss Model. No dust controls are assumed as a worst case.

Water or Incineration or Landfill
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain
from: Cleaning Solid/ Powder Residuals from Containers Used to Transport the Raw Material
basis: EPA/OPPT Solid Residuals in Transport Containers Model, CEB standard 1% residual. The submission esimates 0.001 kg/day/site sent to landfill from container cleaning. Because of multiple unknown, non-submitter controlled sites, EPA assesses 1% release to uncertain media.

Water or Incineration or Landfill
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: Incineration or Landfill
from: Equipment Cleaning Losses of Solids from Process Vessels
basis: EPA/OPPT Equipment Cleaning Losses of Solids from Process Vessels. The submission esimates [redacted] kg/day/site sent to hazardout waste disposal (incineration) from equipment cleaning. Because of multiple unknown, non-submitter controlled sites, EPA assesses release to uncertain media.

Water or Incineration or Landfill
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain
from: Waste/Scrap Disposal
basis: User-Defined Loss Rate Model. The submission estimates [redacted] kg/site-day sent to landfill from waste/scrap material. EPA assesses release to uncertain media, although landfill is likely for scrap material.

RELEASE TOTAL
[redacted] kg/yr - all sites

OCCUPATIONAL EXPOSURES ESTIMATE SUMMARY
Tot. # of workers exposed via assessed routes: [redacted]
Basis: Submission estimates up to [redacted] workers across [redacted] sites, or [redacted] workers per site.

Inhalation:

Exposure to Particulate (non-volatile) (Class I)
Typical:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/kg-day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Worst Case:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/kg-day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with inhalation exposure: [redacted]

Basis: Unloading Solid Raw Material from Transport Containers; EPA Small Volume Handling Model, less than [redacted] kg of solid containing the PMN handled per site-day.

NOTE: The respirator class is: I. Particulate (including solid or liquid droplets).

INHALATION MONITORING DATA REVIEW

1)	Uncertainty (estimate based on model, regulatory limit, or data not specific to industry):	Yes
2)a)	Exposure level > 1 mg/day?	No
	OR	
b)	Hazard Rating for health of 2 or greater? 2	Yes

=> Inhalation Monitoring Data Desired? **No**

Dermal:

Exposure to Solid at [redacted] concentration
High End:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with dermal exposure: [redacted]

Basis: Unloading Solid Raw Material from Transport Containers; EPA/OPPT Direct 2-Hand Dermal Contact with Solids Model.

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Proc 2: Formulation of Coatings Additive ([redacted] PV)

Number of Sites/ Location: [redacted]

unknown site(s)

Days/yr: [redacted]

Basis: The submission estimates [redacted] total use sites. EPA assesses [redacted] of the PV for this operation and therefore assesses [redacted] of the use sites: ([redacted] sites) x [redacted] = ~[redacted] sites. EPA also assumes [redacted] days/yr (consistent with # of exposure days estimated in submission). CS calculates [redacted] kg/st-day.

Process Description: [redacted] (process per past cases)

ENVIRONMENTAL RELEASES ESTIMATE SUMMARY

IRER Note: The daily releases listed for any source below may coincide with daily releases from the other sources to the same medium.

Water or Air or Incineration or Landfill
Conservative: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain (per model)
from: Unloading Solid Raw Material from Transport Containers
basis: EPA/OPPT Solids Transfer Dust Loss Model. No dust controls are assumed as a worst case.

Water or Incineration or Landfill
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain
from: Cleaning Solid/ Powder Residuals from Containers Used to Transport the Raw Material
basis: EPA/OPPT Solid Residuals in Transport Containers Model, CEB standard 1% residual.

Water or Incineration or Landfill
Conservative: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain
from: Equipment Cleaning Losses of Liquids from Multiple Vessels
basis: EPA/OPPT Multiple Process Vessel Residual Model, CEB standard [redacted] residual.

RELEASE TOTAL
[redacted] kg/yr - all sites

OCCUPATIONAL EXPOSURES ESTIMATE SUMMARY
Tot. # of workers exposed via assessed routes: [redacted]
Basis: Submission estimates up to [redacted] workers across [redacted] sites, or [redacted] workers per site.

Inhalation:

Exposure to Particulate (non-volatile) (Class I)
Typical:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose:[redacted] mg/kg-day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose:[redacted] mg/day over [redacted] days/yr
Worst Case:
> Potential Dose Rate: [redacted]mg/day over [redacted] days/yr
> Lifetime Average Daily Dose:[redacted] mg/kg-day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with inhalation exposure: [redacted]
Basis: Unloading Solid Raw Material from Transport Containers; EPA Small Volume Handling Model, less than [redacted] kg of PMN handled per site-day.

NOTE: The respirator class is: I. Particulate (including solid or liquid droplets).

INHALATION MONITORING DATA REVIEW
1) Uncertainty (estimate based on model, regulatory limit, or data not specific to industry): Yes
2)a) Exposure level > 1 mg/day? No
OR
b) Hazard Rating for health of 2 or greater? 2 Yes
=> Inhalation Monitoring Data Desired? **No**

Dermal:

Exposure to [redacted] at [redacted] concentration
High End:
> Potential Dose Rate:[redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with dermal exposure: [redacted]
Basis: Unloading Solid Raw Material from Transport Containers; EPA/OPPT Direct 2-Hand Dermal Contact with Solids Model.

Exposure to [redacted] at [redacted] concentration
High End:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Average Daily Dose: [redacted]mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with dermal exposure: [redacted]
Basis: Loading Liquid Product into Containers; EPA/OPPT 2-Hand Dermal Contact with Liquids Model.

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Use 2: Appication of Coatings ([redacted] PV)

Number of Sites/ Location: [redacted]

unknown site(s)

Days/yr: [redacted]

Basis: No information was available on end coating use. Past cases assumed [redacted] site each for coatings additive processing and use. EPA assumes the same number of coating sites as formulation sites ([redacted] sites). EPA also assumes [redacted] days/yr. CS calculates [redacted] kg/st-day.

Process Description: [redacted] (per past cases)

ENVIRONMENTAL RELEASES ESTIMATE SUMMARY

IRER Note: The daily releases listed for any source below may coincide with daily releases from the other sources to the same medium.

Water or Incineration or Landfill
High End: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: uncertain
from: Cleaning Liquid Residuals from Containers Used to Transport the Raw Material
basis: EPA/OPPT Drum Residual Model, CEB standard 3% residual.

Air
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: Air (10%) and land (90%) GS for automotive refinishing
from: Coating Using Hand-Held Spray Gun
basis: EPA/OPPT Automobile Refinish Coating Overspray Loss Model (non-volatiles). Assessment consistent with past cases.

Landfill
Output 2: [redacted] kg/site-day over [redacted] days/yr from [redacted] sites
or [redacted] kg/site-yr from [redacted] sites or [redacted] kg/yr-all sites
to: Air (10%) and land (90%) GS for automotive refinishing
from: Coating Using Hand-Held Spray Gun
basis: EPA/OPPT Automobile Refinish Coating Overspray Loss Model (non-volatiles). Assessment consistent with past cases.

RELEASE TOTAL
[redacted] kg/yr - all sites

OCCUPATIONAL EXPOSURES ESTIMATE SUMMARY
Tot. # of workers exposed via assessed routes: [redacted]
Basis: No information available. EPA assumes a default minimum of [redacted] workers/site.

Inhalation:

Exposure to Mist (non-volatile) (Class I)
Upper Bound:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/kg-day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with inhalation exposure: [redacted]
Basis: Coating Using Hand-Held Spray Gun; OSHA PNOR PEL-Limiting Model.

NOTE: The respirator class is: I. Particulate (including solid or liquid droplets).

INHALATION MONITORING DATA REVIEW

1)	Uncertainty (estimate based on model, regulatory limit, or data not specific to industry):	Yes
2)a)	Exposure level > 1 mg/day?	Yes
	OR	
b)	Hazard Rating for health of 2 or greater? 2	Yes

=> Inhalation Monitoring Data Desired? **No**

Dermal:

Exposure to Liquid at [redacted] concentration
High End:
> Potential Dose Rate: [redacted] mg/day over [redacted] days/yr
> Lifetime Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Average Daily Dose: [redacted] mg/day over [redacted] days/yr
> Acute Potential Dose: [redacted] mg/day over [redacted] days/yr
Number of workers (all sites) with dermal exposure: [redacted]
Basis: Unloading Liquid Raw Material from Containers; EPA/OPPT 2-Hand Dermal Contact with Liquids Model.